

### **REMARKS/ARGUMENTS**

Reconsideration of this application is requested. Claims 16-35 will be active in the application subsequent to entry of this Amendment. The amendments made to the claims are discussed in detail below and in the attached Synopsis.

Responding to items 1-7 of the Official Action, counsel affirms the election of Group I, that is claims 1-12 drawn to a process. Non-elected claims 13-15 have been canceled but without prejudice to divisional applications directed to the subject matter of these claims.

In order to make the present invention clearer, original claims 1 to 12 are canceled and new claims 16 to 35 are added. Of these new claims 16 to 35, the independent claims are claims 16, 17, 20, 21, 22 and 23. These independent claims are combinations of the present claim 1 as a base with added constituents and/or requirements. Each independent claim will be explained individually below.

(1) Independent claim 16

In the present claim 1,

- (a) "press-molding" is limited to "precision press-molding",
- (b) it is specified that the glass contains  $P_2O_5$ ,
- (c) "an oxidizing atmosphere" is limited to "an oxidizing atmosphere having the vapor partial pressure of water vapor adjusted to  $10^4$  Pa or lower", and
- (d) "to decolor the glass molded article" is added to the end of the claim 1.

(2) Independent claim 17

In the present claim 1,

- (a) "press-molding" is limited to "precision press-molding",
- (b) it is specified that the glass contains  $P_2O_5$ ,
- (c) it is specified that the glass has an  $Sb_2O_3$  content of 2,000 ppm or less and an  $As_2O_3$  content of 200 ppm or less, and
- (d) "to decolor the glass molded article" is added to the end of the claim 1.

(3) Independent claim 20

In the present claim 1,

(a) "press-molding" is limited to "precision press-molding",

(b) it is specified that the glass contains  $P_2O_5$ ,

(c) it is specified that the glass to be press-molded is a preform having a surface formed of a carbon film,

(d) it is specified that the heat treatment is carried out in atmosphere of air, and

(e) "to decolor the glass molded article" is added to the end of the claim 1.

(4) Independent claim 21

In the present claim 1,

(a) "press-molding" is limited to "precision press-molding",

(b) it is specified that the glass contains  $P_2O_5$ , contains no lead and has a  $WO_3$  and  $Nb_2O_5$  total content of at least 15 mol%,

(c) it is specified that the glass has a refractive index (nd) of at least 1.6 and an Abbe's number (vd) of 33 or less, and

(d) "to decolor the glass molded article" is added to the end of the claim 1.

(5) Independent claim 22

In the present claim 1,

(a) it is specified that the glass contains  $P_2O_5$ , contains no lead and has a  $WO_3$ ,  $Nb_2O_5$  and  $TiO_2$  total content of at least 25 mol%,

(b) it is specified that the glass has a refractive index (nd) of at least 1.6 and an Abbe's number (vd) of 33 or less, and

(c) "to decolor the glass molded article" is added to the end of the claim 1.

(6) Independent claim 23

Independent claim 23 is a combination of independent claims 17 and 21.

Basis for the above amendments to the independent claims and their relationship to the original claims are detailed in the attached Synopsis.

Having discussed the content of the new claims presented above and the relationship to the previous claims and description of the invention, attention is now focused on applicants' contribution to the art.

The present invention is a process for producing a glass molded article, defined in each of new independent claims 16, 17, 20, 21, 22 and 23, and includes carrying out step (A) of press-molding a glass containing at least one oxide selected from  $\text{WO}_3$ ,  $\text{Nb}_2\text{O}_5$  or  $\text{TiO}_2$  in a non-oxidizing atmosphere to obtain a glass molded article, and carrying out step (B) of heat-treating the glass molded article in an oxidizing atmosphere (or an atmosphere of air as specified in claim 20) to decolor the glass molded article.

Of these, step (A) is known, as stated in the present specification, pages 1 – 2, while step (B) is a required characteristic of the present invention.

The present invention has been made on the basis of the following new findings (i) to (iii) by the present inventors:

(i) In a non-oxidizing atmosphere, a glass containing  $\text{WO}_3$ ,  $\text{Nb}_2\text{O}_5$  or  $\text{TiO}_2$  in a high-temperature state is colored since the W, Nb or Ti ion is reduced, and in an oxidizing atmosphere, the above glass is decolored since the W, Nb or Ti ion is oxidized, so that the color degree reversibly changes (see paragraph [0007]).

(ii) Even if a glass containing  $\text{WO}_3$ ,  $\text{Nb}_2\text{O}_5$  or  $\text{TiO}_2$  is not colored, a glass molded article obtained from it is undesirably colored since it is in a heated state during the precision press-molding and it is in a non-oxidizing atmosphere and since the W, Nb or Ti ion is accordingly reduced (see paragraph [0007]).

(iii) A glass molded article that is colored by the precision press molding is heat-treated in an oxidizing atmosphere, whereby the glass molded article is decolored, to provide a transparent glass molded article having a high transmittance (see paragraphs [0008] and [0062]).

As specified in independent claims 16, 17, 20, 21, 22 and 23, the glass to be press-molded contains  $\text{P}_2\text{O}_5$  as an essential component. The reason for this is as follows: As described in paragraph [0015], a phosphate glass containing  $\text{P}_2\text{O}_5$  exhibits a large

diffusion coefficient of hydrogen ions and promotes the oxidation of W, Nb or Ti ions in an oxidizing atmosphere, so that  $P_2O_5$  provides a significant effect on decoloring a glass molded article.

In independent claim 16, the partial pressure of water vapor in the oxidizing atmosphere is limited to  $10^4$  Pa or lower. The reason for this is as follows: As described in paragraph [0015], the diffusion of hydrogen ion affects a change in color degree, and hydrogen ion in a glass is rapidly freed out of the glass in the form of  $H_2O$ , whereby the color degree can be rapidly decreased. To make full utilization of this function aggressively, it is preferred to carry out the heat treatment under the above water vapor partial pressure.

In independent claims 17 and 23, the content of  $Sb_2O_3$  in the glass is limited to 2,000 ppm or less, and the content of  $As_2O_3$  in the glass is limited to 200 ppm or less. The reason for these limitations is as follows:

$Sb_2O_3$  and  $As_2O_3$  are added to an optical glass for improving clarification. For example, see "DATA BOOK OF GLASS COMPOSITION" attached hereto which shows that most of SF glass compositions disclosed in the cited JP6-32623 contain 0.3 to 1.0 % by weight of  $As_2O_3$ .  $Sb_2O_3$  and  $As_2O_3$  not only have a clarification function but also work to suppress the coloring of a glass. However, they have an adverse effect in that they oxidize a molding surface of a mold during precision press-molding and decrease the working lifetime of the mold (if the molding surface of a mold for precision press-molding is even slightly deteriorated, the mold can easily become non-usable unlike a mold for general press-molding). It is therefore desirable to decrease the amounts of  $Sb_2O_3$  and  $As_2O_3$ , particularly the amount of  $As_2O_3$  as it has a strong oxidizing power. When the amounts of  $Sb_2O_3$  and  $As_2O_3$  are decreased, however, the tendency of the glass molded article being colored is intensified, so that this causes a problem of a glass molded article being colored.

According to independent claims 17 and 23, an effect is produced that when a precision press-molded article made of a glass having suppressed  $Sb_2O_3$  and  $As_2O_3$

contents is heat-treated in an oxidizing atmosphere, glass molded articles that are least colored can be produced while the lifetime of the mold can be increased.

Independent claim 20, includes a limitation that since the glass to be press-molded is "a preform having a surface formed of a carbon film", the heat treatment is carried out in an atmosphere of air. This limitation is introduced to distinguish the claim from the cited JP 6-32623.

As is clear from the Abstract of the partial translation of the cited JP 6-32623, the invention of JP 6-32623 is premised on use of an optical glass raw material into which carbon is ion-injected. In a glass surface, therefore, a mixture of glass components with carbon is present, and the carbon reduces the glass components during annealing to color a glass if the carbon is not rapidly oxidized, so that it is arranged that the annealing atmosphere has a higher oxygen concentration than that of air.

In independent claim 20, carbon is present in the surface of a preform. However, the invention of independent claim 20 differs from the invention of the cited JP 6-32623 in that the carbon is not injected and is instead present uniformly in the form of a coating (carbon film). Even in heat treatment in the atmosphere of air, therefore, the carbon film is rapidly removed, and thus the glass is not reduced and the glass molded article is not colored.

For the reasons explained above, disclosure of the cited JP 6-32623 differs from the present invention as defined by these new claims.

Independent claims 21, 22 and 23 have limitations that each glass used contains no lead and that the total content of  $\text{WO}_3$  and  $\text{Nb}_2\text{O}_5$  in claims 21 and 23 is at least 15 mol% or the total content of  $\text{WO}_3$ ,  $\text{Nb}_2\text{O}_5$  and  $\text{TiO}_2$  in claim 22 is at least 25 mol%.

Lead as a glass component is used for imparting a glass with a high refractive index, but its use is restricted due to environmental problems. To obtain a high-refractivity and low-dispersion glass having a refractive index ( $n_d$ ) of at least 1.6 and an Abbe's number ( $v_d$ ) of 33 or less, it is necessary to increase the total amount of  $\text{WO}_3$  and

$\text{Nb}_2\text{O}_5$  or the total amount of  $\text{WO}_3$ ,  $\text{Nb}_2\text{O}_5$  and  $\text{TiO}_2$ . This, however, causes a problem of the glass being colored.

Even in the above case, however, according to the independent claims 21, 22 and 23, coloring of glass molded articles can be decreased by heat-treating them in an oxidizing atmosphere.

Attention is now directed to the prior art-based rejections in items 9-10 of the Official Action. Both rejections place reliance upon the discussion contained on pages 1 and 2 of applicants' specification relating to background of the present invention in combination with two separate documents, one a textbook and the other a published Japanese patent application.

In Paragraph 9 of the Official Action, the Examiner states that Kingery et al disclose that a glass is annealed out after the pressing of the glass. However, the annealing described by Kingery et al is carried out as Kingery itself states for removing residual stress that is caused by the pressing of the glass -- it is not carried out for decoloring a glass that is colored. Further, Kingery et al do not recognize or disclose any problem of undesirable coloring that occurs after press-molding, which problem is inherent in a glass containing  $\text{WO}_3$ ,  $\text{Nb}_2\text{O}_5$  or  $\text{TiO}_2$ , nor do they disclose any of the technical means of the present invention for carrying out the heat-treating in an oxidizing atmosphere for overcoming the above coloring problem.

As explained above, Kingery et al disclose none of the above-mentioned features of the new independent claims 16, 17, 20, 21, 22 and 23, so that these claims are not obvious over Applicant's admitted art in view of Kingery et al.

In paragraph 10 of the Office Action, the Examiner states that JP 6-32623 discloses that a glass material is press-molded and then annealed in an atmosphere having higher oxygen concentration than that of air.

However, JP 6-32623 differs from the present invention in the following points.

(i) JP 6-32623 describes almost nothing concerning glass compositions, and only paragraph [0013] describes SF glasses (components Si, O, Pb, etc.).

When the DATA BOOK OF GLASS COMPOSITION attached hereto is reviewed for SF glass compositions, the SF glasses differ from the glasses of independent claims 16, 17, 20, 21, 22 and 23 in that the SF glasses contain no  $P_2O_5$ . Further, the SF glasses (excluding SF 54 and SF 110) differ from the glasses of independent claims 21 and 22 in that the SF glasses contain PbO. Further, the SF glasses (excluding SF 110) contain large amounts of  $As_2O_3$  and  $Sb_2O_3$ , and on this point, the SF glasses differ from the glass of independent claims 17 and 23 in which the amounts of  $Sb_2O_3$  and  $As_2O_3$  are limited.

Since the compositions of the SF glasses are completely different from the composition of a glass containing  $WO_3$ ,  $Nb_2O_5$  or  $TiO_2$ , there is no necessity nor motivation for combining the teaching of the SF glasses in JP 6-32623, with the Applicant admitted prior art relating to glass composition containing  $WO_3$ ,  $Nb_2O_5$  or  $TiO_2$ .

(ii) In the invention of JP 6-32623, annealing is carried out in an oxidizing atmosphere having a higher oxygen concentration than air, and this oxidizing atmosphere differs from an oxidizing atmosphere having a partial pressure of water vapor of  $10^4$  Pa or less as required in independent claim 16 and an atmosphere of air in independent claim 20. The signification of the definition of the oxidizing atmosphere in claims 16 and 20 is discussed above.

(iii) The glass of JP 6-32623 thereof has a surface that is carbon ion-injected and which is formed of a glass material containing a mixture of glass components with carbon. This glass differs from the "preform having a surface formed of a carbon film" required in claim 20.

The significance of definition of the glass preform recited in the claim 20 is also discussed above.

For at least these three reasons (i) to (iii), the invention of JP 6-32623 is clearly different from independent claims 16, 17, 20, 21, 22 and 23 both in constitution and effect, so that these independent claims are not obvious over JP 6-32623 in view of technical matters admitted by Applicant.

HAYASHI, K. et al.  
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For the above reasons it is respectfully submitted that the claims of this application define inventive subject matter. Reconsideration and allowance are solicited.

Respectfully submitted,

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**SYNOPSIS OF REVISED/NEW CLAIMS AND BASIS FOR SAME**

16 (present claim 1 + limitations underlined)

A process for producing a glass molded article by precision press-molding a glass under heat in a non-oxidizing atmosphere,

the process comprising precision press-molding a glass containing  $P_2O_5$  and at least one oxide selected from  $WO_3$ ,  $Nb_2O_5$  or  $TiO_2$ , to prepare a glass molded article, and then heat-treating the glass molded article in an oxidizing atmosphere having the partial pressure of water vapor adjusted to  $10^4$  Pa or lower to decolor the glass molded article.

The "precision" of the above "precision press-molding" is supported by "a precision press-molding" in the specification, paragraph [0015].

It is described in the specification, page 11, paragraph [0019] that the glass contains  $P_2O_5$ .

The term "the partial pressure of water vapor adjusted to  $10^4$  Pa or lower" is supported in the specification, page 9, lines 12-14, as a preferred aspect of the invention.

Further, "to decolor the glass molded article" is described and explained in the specification, paragraphs [0006], [0007], [0009], [0062], as well as other passages.

17 (present claim 1 + limitations underlined)

A process for producing a glass molded article by precision press-molding a glass under heat in a non-oxidizing atmosphere,

the process comprising precision press-molding a glass containing  $P_2O_5$  and at least one oxide selected from  $WO_3$ ,  $Nb_2O_5$  or  $TiO_2$  and having an  $Sb_2O_3$  content of 2,000 ppm or less and an  $As_2O_3$  content of 200 ppm or less to prepare a glass molded article, and then heat-treating the glass molded article in an oxidizing atmosphere to decolor the glass molded article.

The  $Sb_2O_3$  content and the  $As_2O_3$  content are described in the specification, paragraph [0038].

18 (New claim)

The process of claim 17, wherein said glass contains no  $\text{As}_2\text{O}_3$ .

New claim 18 is supported by "a glass molded article formed of a glass containing no  $\text{As}_2\text{O}_3$ " in the specification, paragraph [0038].

19 (New claim 17 + limitations underlined)

The process of claim 17, wherein the precision press-molding is carried out with a press mold having a molding surface made of SiC or hard carbon.

The material for the molding surface is described in the specification, page 9, line 4 from the bottom. SiC and hard carbon are materials particularly susceptible to degradation caused by oxidation, and it is required to decrease the content of  $\text{Sb}_2\text{O}_3$  and  $\text{As}_2\text{O}_3$  in a glass. The present invention produces a remarkable effect when a molding surface is made of SiC or hard carbon.

20 (Present claim 1 + limitations underlined)

A process for producing a glass molded article by precision press-molding a glass under heat in a non-oxidizing atmosphere,

the process comprising precision press-molding a preform made of a glass containing  $\text{P}_2\text{O}_5$  and at least one oxide selected from  $\text{WO}_3$ ,  $\text{Nb}_2\text{O}_5$  or  $\text{TiO}_2$  and having a surface formed of a carbon film, to prepare a glass molded article, and then heat-treating the glass molded article in atmosphere of air to decolor the glass molded article.

Conducting the heat-treatment in an air atmosphere is supported in the specification, paragraph [0012] and "a preform .... having a surface formed of a carbon film" is supported in the specification, paragraph [0048].

21 (Present claim 1 + limitations underlined)

A process for producing a glass molded article by precision press-molding a glass under heat in a non-oxidizing atmosphere,

the process comprising precision press-molding a glass containing  $\text{P}_2\text{O}_5$  and at least one oxide selected from  $\text{WO}_3$ ,  $\text{Nb}_2\text{O}_5$  or  $\text{TiO}_2$ , containing no lead, having a  $\text{WO}_3$  and  $\text{Nb}_2\text{O}_5$  total content of at least 15 mol% and having a refractive index (nd) of at least 1.6 and an Abbe's number (vd) of 33 or less, to prepare a glass molded article, and then

heat-treating the glass molded article in an oxidizing atmosphere to decolor the glass molded article.

The term "containing no lead" is explained in the specification, page 19, line 8 from the bottom. The words "a  $\text{WO}_3$  and  $\text{Nb}_2\text{O}_5$  total content" are described in the specification, page 17, [paragraph 0036]. The features "a refractive index (nd) of at least 1.6 and an Abbe's number (vd) of 33 or less" are described in the specification, page 10, paragraph [0016].

22 (Present claim 1 + limitations underlined)

A process for producing a glass molded article by press-molding a glass under heat in a non-oxidizing atmosphere,

the process comprising press-molding a glass containing  $\text{P}_2\text{O}_5$  and at least one oxide selected from  $\text{WO}_3$ ,  $\text{Nb}_2\text{O}_5$  or  $\text{TiO}_2$ , containing no lead, having a  $\text{WO}_3$ ,  $\text{Nb}_2\text{O}_5$  and  $\text{TiO}_2$  total content of at least 25 mol% and having a refractive index (nd) of at least 1.6 and an Abbe's number (vd) of 33 or less, to prepare a glass molded article, and then heat-treating the glass molded article in an oxidizing atmosphere to decolor the glass molded article.

The total content of  $\text{WO}_3$ ,  $\text{Nb}_2\text{O}_5$  and  $\text{TiO}_2$  is described in the specification, page 17, paragraph [0036].

23. (a combination of new claims 17 and 21)

A process for producing a glass molded article by precision press-molding a glass under heat in a non-oxidizing atmosphere,

the process comprising precision press-molding a glass containing  $\text{P}_2\text{O}_5$  and at least one oxide selected from  $\text{WO}_3$ ,  $\text{Nb}_2\text{O}_5$  or  $\text{TiO}_2$  containing no lead, having an  $\text{Sb}_2\text{O}_3$  content of 2,000 ppm or less and an  $\text{As}_2\text{O}_3$  content of 200 ppm or less and having a  $\text{WO}_3$  and  $\text{Nb}_2\text{O}_5$  total content of at least 15 mol% and having a refractive index (nd) of at least 1.6 and an Abbe's number (vd) of 33 or less, to prepare a glass molded article, and then heat-treating the glass molded article in an oxidizing atmosphere to decolor the glass molded article.

24. The process of claim 23, wherein the glass contains no  $\text{As}_2\text{O}_3$ .

25. The process of claim 23, wherein the press-molding is carried out with a press mold having a molding surface made of SiC or hard carbon.

26. (Present claim 3)

The process of any one of claims 17, 20, 21, 22 and 23, wherein the heat treatment is carried out in a dry atmosphere.

27. (Present claim 4)

The process of any one of claims 16, 17, 20, 21, 22 and 23, wherein the glass molded article is heat-treated at a temperature equivalent to, or lower than, a glass transition temperature of the glass.

28. (Present claim 7 + limitation underlined)

The process of any one of claims 16, 17, 20, 21, 22 and 23, wherein the glass has a glass transition temperature ( $T_g$ ) of  $540^\circ\text{C}$  or lower and is precision press-molded.

29. (Present claim 8)

The process of claim 16, 17 or 20, wherein the glass is molded into a glass molded article made of an optical glass having a refractive index ( $n_d$ ) of at least 1.6 and an Abbe's number ( $v_d$ ) of 33 or less.

30. (Present claim 9)

The process of any one of claims 16, 17, 20, 21, 22 and 23, wherein the glass molded article is formed from a glass containing, by mol%, 12 to 50 % of  $\text{P}_2\text{O}_5$ , 2 to 45 % of  $\text{WO}_3$ , 0 to 25 % of  $\text{Nb}_2\text{O}_5$ , 0 to 22 % of  $\text{TiO}_2$ , 0 to 30 % of  $\text{Li}_2\text{O}$ , 0 to 33 % of  $\text{Na}_2\text{O}$ , 0 to 25 % of  $\text{K}_2\text{O}$ , 0 to 23 % of  $\text{B}_2\text{O}_3$ , 0 to 25 % of  $\text{BaO}$  and 0 to 20 % of  $\text{ZnO}$  and having a  $\text{WO}_3$  and  $\text{Nb}_2\text{O}_5$  total content of 45 mol% or less.

31. (Present claim 10)

The process of claim 30, wherein the molded article is formed from the glass containing, by mol%, 2 to 30 % of  $\text{Li}_2\text{O}$  and 2 to 33 % of  $\text{Na}_2\text{O}$ .

32. (Present claim 11)

The process of claim 30, wherein the molded article is formed from the glass containing, by mol%, 5 to 25 % of  $\text{Nb}_2\text{O}_5$ , 1 to 22 % of  $\text{TiO}_2$ , 0.5 to 23 % of  $\text{B}_2\text{O}_3$  and 1 to 25 % of  $\text{BaO}$ , having an alkali metal oxide total content of 45 mol% or less and having an alkaline earth metal oxide and  $\text{ZnO}$  total content of 35 mol% or less.

Claim 32 is directed to a glass containing  $\text{Nb}_2\text{O}_5$  and  $\text{TiO}_2$  which are easily colorable components.

33 -35. (Present claim 12)